



UNCLASSIFIED. DISTRIBUTION STATEMENT A.
Approved for public release; unlimited public
distribution.



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

US Army Ground Systems Alternative Fuels Update

Luis A. Villahermosa
Team Leader, Fuels and Lubricants Technology Team
luis.a.villahermosa.civ@mail.mil

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 27 JUN 2011		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE US Army Ground Systems Alternative Fuels Update			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Luis A. Villahermosa			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA			8. PERFORMING ORGANIZATION REPORT NUMBER 21930		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA			10. SPONSOR/MONITOR'S ACRONYM(S) TACOM/TARDEC/RDECOM		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) 21930		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 7	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

- Two alternative fuels for which evaluations are being completed to assess their impacts on tactical ground systems
 - Blends of JP-8 and up to 50% by volume of
 - Fischer-Tropsch Synthetic Paraffinic Kerosene (FT SPK)
 - Hydroprocessed Renewable Jet (HRJ)
 - Both products (FT SPK and HRJ) are very similar compositionally
 - Resultant properties are very similar
 - Evaluations thus conducted using one of these blends will be representative of evaluations for the other by similarity
 - Evaluations are conducted using nominal 50:50 blends (volumetric basis)
- Several types of evaluations already completed or planned
 - Laboratory bench-top testing
 - Rig testing of fuel injection systems
 - Tactical vehicle engine testing
 - Pilot demonstrations in tactical ground systems (vehicles, force projection equipment, generator sets)

- Tactical Wheeled Vehicle Pilot Field Demo conducted at Ft. Bliss, TX (2009)
 - Half of fleet on JP-8, other half on synthetic fuel blend
 - Miles driven per driver training protocol
 - No issues, no discernible differences of vehicle performance/maintenance between the fuels
- HMMWV Test Track Evaluation (2009)
 - GEP 6.5L non-turbo evaluated
 - Loaded vs. unloaded, uphill vs. flat vs. downhill, on-road vs. off-road
 - Test fuels: DF2, JP-8, FT SPK, and FT SPK/JP-8 blend
 - Noticeable acceleration loss using blend
- Tactical Generator Set Pilot Demo (2007)
 - Three 10-kW generator sets in side-by-side operation
 - 1000 hours total test time each
 - Test fuels: DF2 (break-in), JP-8, FT SPK, and FT SPK/JP-8 blend
 - No issues



TARDEC photo by R. Alvarez,
TARDEC Fuels & Lubricants Research Facility

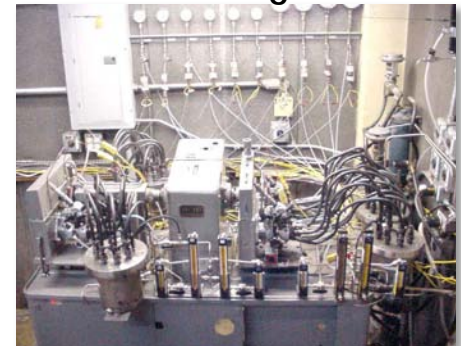
- Endurance testing of tactical vehicle engines
- Modified NATO 400-Hour Cycle testing conducted at TARDEC Propulsion Lab (2008-2010)
 - Engines tested (2008-2010)
 - GEP 6.5L Turbo (HMMWV)
 - CAT 7.2L Engine (Stryker, FMTV)
 - Cummins V903T Engine (Bradley) (2010)
 - DDC 8V92-TA Engine (HEMTT) (2010 – Report Pending)
 - Power curves generated at start of, during, and at end of test
 - Testing at elevated/desert temperatures whenever possible
 - Test fuels: JP-8 (baseline) and FT SPK/JP-8 Blend
 - Slight power differences between JP-8 and the blend
- Army/CRC 210-Hour Wheeled Vehicle Cycle testing conducted at TARDEC Fuels & Lubricants Facility (2007)
 - CAT 7.2L Engine (Stryker, FMTV)
 - Twice through (2X) 210-hr test cycle performed using FT SPK (100%)
 - Power curves generated at start and end of test for ULSD, JP-8, FT SPK, FT SPK/JP-8 blend
 - No issues



6.5L Turbo Engine

- Laboratory evaluations of FT SPK
 - Elastomer Compatibility / O-ring Studies (2003-2006)
 - Fuel Blend Studies (2005-2006)
 - Cetane Study (2008-2009)
 - Measured, calculated, and derived
 - Lubricity Study (2008-2009)
 - BOCLE, SLBOCLE, and HFRR
- Rotary injection fuel pump evaluation (2004)
 - FT SPK neat and FT SPK treated with military-approved lubricity improver additive (CI/LI)
 - Testing not done at elevated temperatures
 - Pump failure after just 96 hours with untreated FT SPK
 - Pump ran full test (500 hours) with treated FT SPK

Rotary fuel injection pump
test rig



TARDEC photo by E. Frame,
TARDEC Fuels & Lubricants Research Facility

- Modified NATO 400-Hour Cycle testing of selected tactical vehicle engines (HRJ/JP-8 blend)
 - Continental 1790 (Recovery Vehicle)
 - Navistar MaxxForce 9.3L (MRAP)
 - GEP 6.5L Turbo (HMMWV)
- Army/CRC 210-Hour TWV Cycle testing at TFLRF
 - Ford Scorpion 6.7L (Joint testing with USAF)
 - Test fuels: ULSD, JP-8, neat FT SPK, and JP-8/FT SPK blend
 - “Desert-like” conditions
 - CAT C7 (neat HR Diesel)
 - Ambient and “desert-like” conditions
- Rotary injection fuel pump testing, high temperature (FT SPK/JP-8 blend)
- High pressure common rail fuel system testing
(blends of FT SPK or HRJ with JP-8)
- Tactical generator sets, 10 kW to 100 kW sizes (HRJ/JP-8 Blend)
 - In coordination with CERDEC
 - 1500-hour reliability testing
 - Other performance testing (electrical characteristics, fuel consumption, etc.)
- Pilot field demonstration of Force Projection equipment operating on fuel blend (HRJ/JP-8 Blend)



Completed TARDEC Evaluations Reports and Papers



Document Title	Publication	Publication Reference	
	Date	DTIC	Other
Synthetic Fuel Lubricity Evaluations	Sep-03	ADA421822	Interim Report TFLRF No. 367
Synthetic JP-5 Aviation Turbine Fuel Elastomer Compatibility	Nov-03	ADA477802	TARDEC Report No. 13978
Exhaust Emissions From a 6.5L Diesel Engine Using Synthetic Fuel and Low-Sulfur Diesel Fuel	Dec-03	ADA426513	Interim Report TFLRF No. 370
Alternative Fuels: Assessment of Fischer-Tropsch Fuel for Military Use in 6.5L Diesel Engine	Jan-04	--	SAE Paper No. 2004-01-2961
Evaluation of Ball on Three Disks as Lubricity Evaluator for CI/LI in Synthetic JP-5	Apr-04	ADA462280	TARDEC Report No. 13977
Synthetic Fischer-Tropsch (FT) JP-5/JP-8 Aviation Turbine Fuel Elastomer Compatibility	Feb-05	ADA477802	TARDEC Report No. 15043
Bench Top Lubricity Evaluator Correlation with Military Rotary Fuel Injection Pump Test Rig	Oct-05	ADA524925	SAE Paper No. 2005-01-3899
Properties of Fischer-Tropsch (FT) Blends for Use in Military Equipment	Apr-06	ADA521910	SAE Paper No. 2006-01-0702
Elastomer Impact When Switch-Loading Synthetic Fuel Blends and Petroleum Fuels	Jul-06	ADA459513	TARDEC Report No. 16028
The Effect of Switch-Loading Fuels on Fuel-Wetted Elastomers	Jan-07	ADA497968	SAE Paper No. 2007-01-1453
Evaluation of Synthetic Fuel in Military Tactical Generators	Jun-08	ADA482914	Interim Report TFLRF No. 392
Engine Durability Evaluation Using Synthetic Fuel, Caterpillar C7 Engine	Oct-08	ADA494498	Interim Report TFLRF No. 391
Fischer-Tropsch Synthetic Fuel Evaluations: HMMWV Test Track Evaluation	Sep-09	ADA509165	Interim Report TFLRF No. 400
Evaluation of the Fuel Effects of Synthetic JP-8 Blends on the 6.5L Turbo Diesel V8 from General Engine Products (GEP) Using the NATO Standard Engine Laboratory Test AEP-5, Edition 3, May 1988	Dec-09	--	TARDEC Report, Distr A
Durability Evaluation of Two New Production Caterpillar C7 Engines Subjected to Elevated Temperature 400 Hour NATO Tests Fueled by JP-8 and 50%/50% Blend of JP-8 and S-8	Feb-10	--	TARDEC Report, Distr E
Synthetic Fuel Blend Demonstration Program at Fort Bliss, Texas	May-10	ADA533890	Interim Report TFLRF No. 407
Lubricity and Derived Cetane Number Measurements of Jet Fuels, Alternative Fuels and Fuel Blends	Jul-10	ADA529442	Interim Report TFLRF No. 405
Cummins V903 Alternative Fuel Evaluation, NATO Modified Standard Laboratory Test AEP-5	May-11	ADB369316	TARDEC Report, Distr D